arcsec

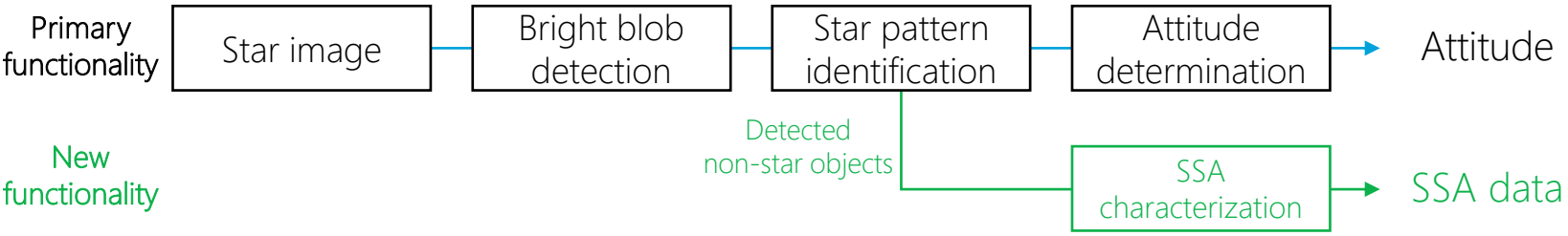
AN AUTONOMOUS APPROACH TO DETECTING, CHARACTERIZING AND ASSESSING THREATS TO SPACE-BASED ASSETS

ARCSEC

The mission of arcsec is to deliver the highest accuracy, compact attitude determination and control systems

DEDUST

Star trackers are optical sensors on board of satellites that detect stars to determine the attitude of the spacecraft.

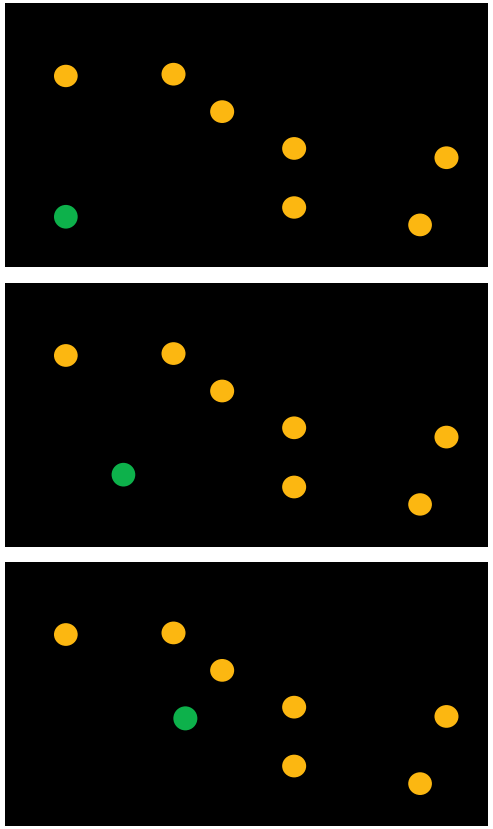


Star trackers are ideal sensors to detect and track space debris:

- Debris of 50 cm from >200km away
- Debris of 20 cm from 100 km away
- Debris of 10 cm from 50 km away
- Debris of 3 cm from 25 km away
- ....

(spherical objects, reflectance of 0.1, optimal reflecting angle)

Detected stars and detected space debris in 3 consecutive images



Space debris is clearly distinguished from stars.

It is detected and characterized through its movement in consecutive images.

We will add the capability to detect and characterize space debris to our star trackers, giving them a secondary functionality as high-performance space-based debris detection sensors.

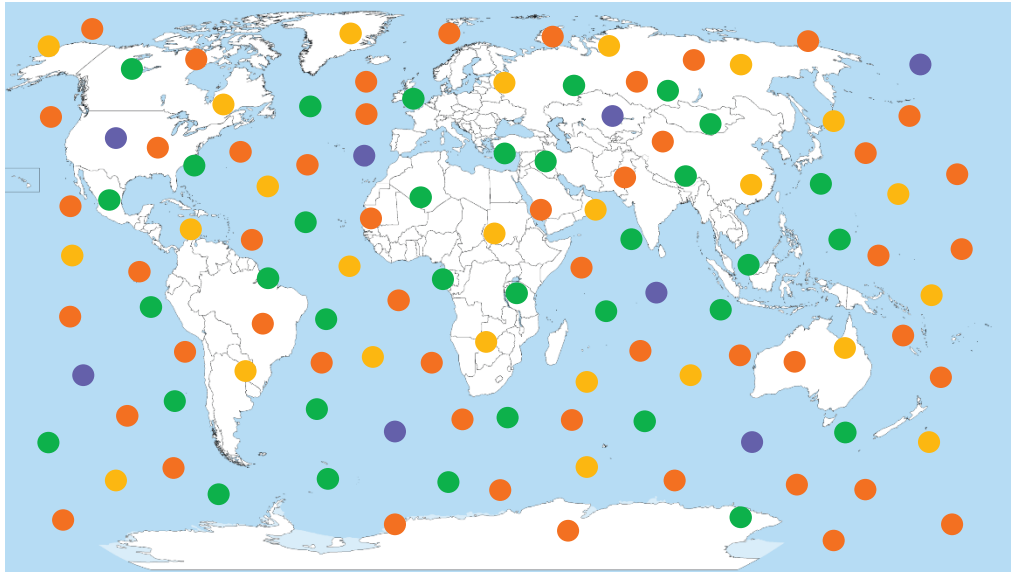
DEDUST

The unique selling point of the proposed solution is its

scalability:

Almost all spacecraft already include a star tracker as part of their standard spacecraft bus!

→ By adding SSA capability to our star trackers, a large-scale multi-sensor network is set up rapidly and in a very cost-effective way

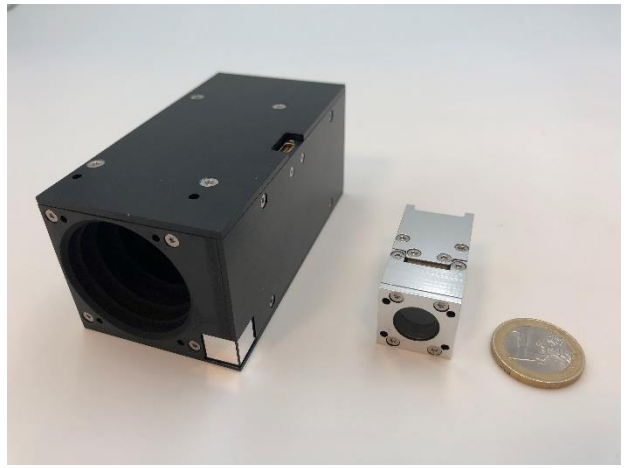


Arcsec star tracker sales:

2021 2022 2023 2024

Additional advantages:

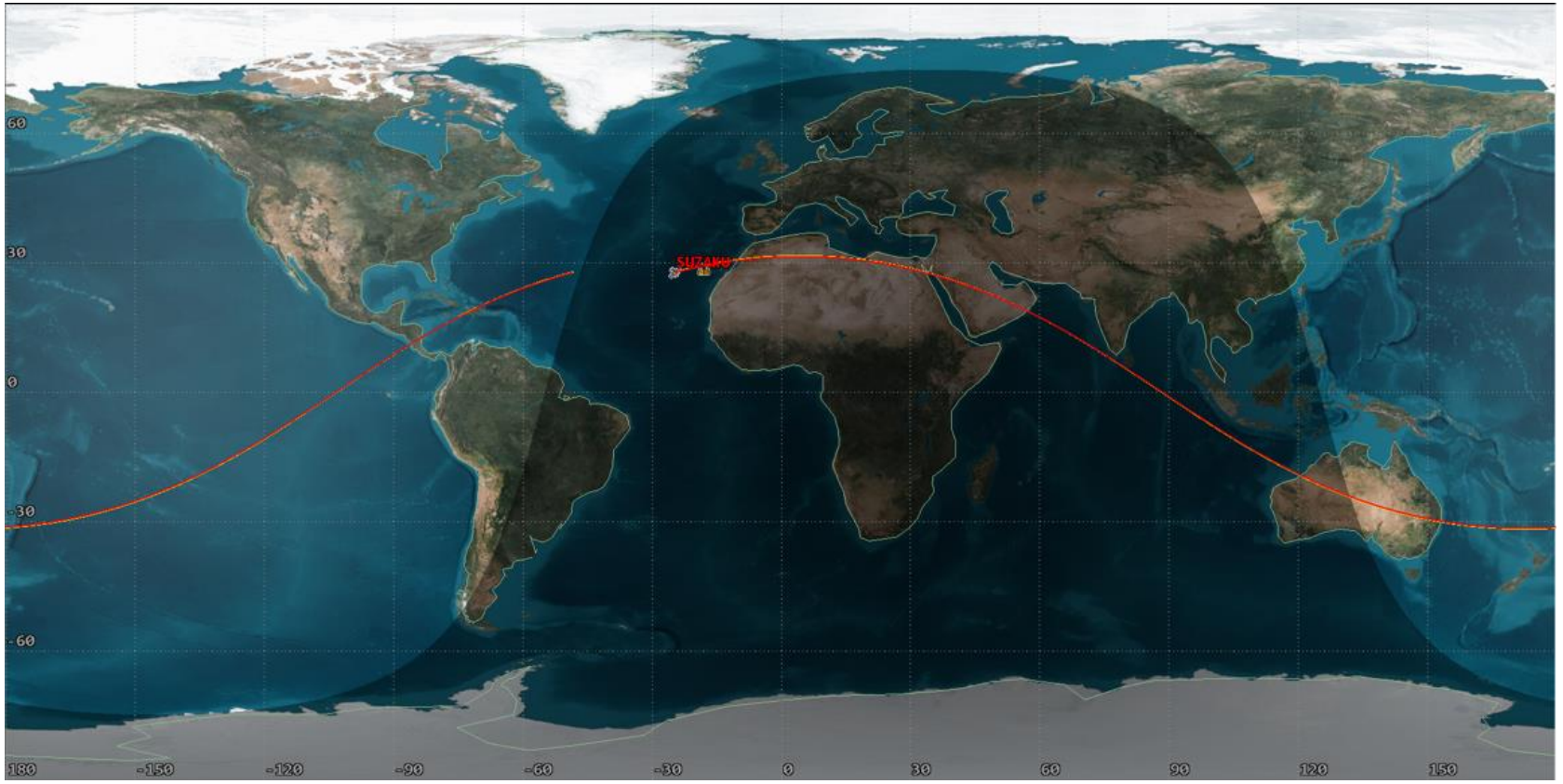
- ✓ As opposed to other space-based systems, no dedicated satellites with dedicated payloads are needed.
- ✓ The debris is detected with the same sensor that determines the spacecraft attitude, allowing to calculate the debris orbit with high accuracy. Brightness information gives information on debris size.
- ✓ Debris < 10 cm is detected by the system.
- ✓ Arcsec's star trackers are reprogrammable in orbit: Already launched sensors can be augmented with SSA capability and the network can be updated in orbit.

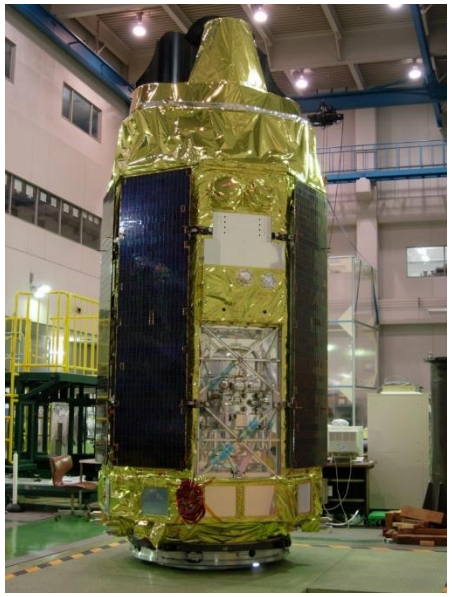


Arcsec's Sagitta and Twinkle star tracker

DEDUST

First space element was characterized using our Sagitta star tracker mounted on the Mercator Telescope at La Palma.

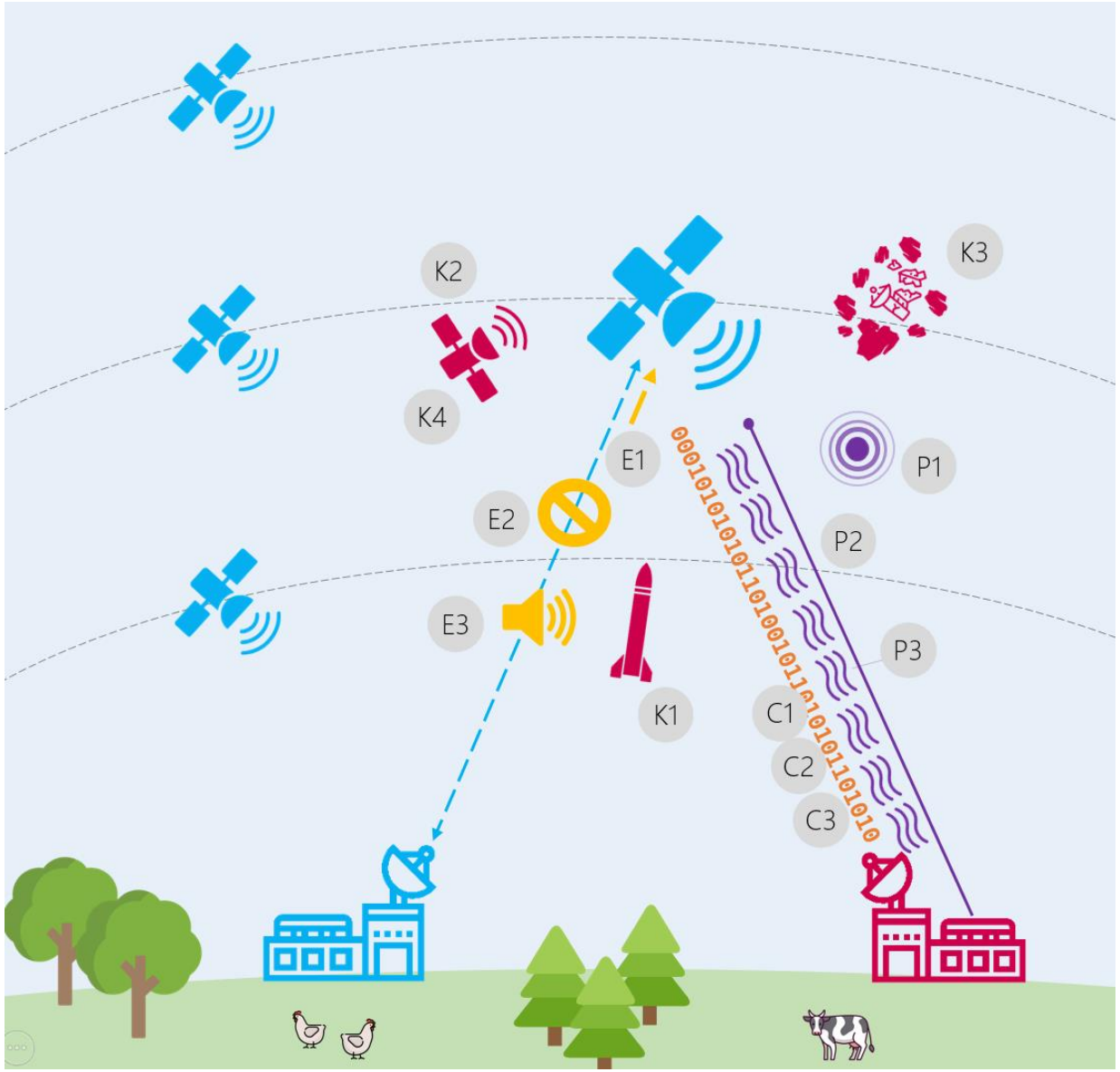




The first detected object was the Suzaku satellite.

THREATS AND SUPPORT

Category	ID	Threat
Kinetic physical	K1	Ground-launched anti satellite weapon
	K2	Co-orbital anti-satellite weapon
	K3	Intended space debris
	K4	Adversarial close proximity operations
Non-kinetic physical	P1	EM pulse
	P2	High-energy lasers
	P3	High-power microwave
Electronic	E1	Interference
	E2	Uplink/downlink jamming
	E3	Uplink/downlink spoofing
Cyber	C1	Data interception & corruption (uplink)
	C2	Data interception & corruption (downlink)
	C3	Command and/or payload intrusion



THREATS AND SUPPORT

Star trackers (used in a stereoscopic design) can provide high-accuracy, high-frequency information during (defense against) close-proximity operations.

Case	Satellites intercommunicating	Other object attitude control	Other object orbit control	Other object characteristics known
Existing docking cases	Yes	Cooperative	Cooperative	Yes
Satellite servicing	Yes/No	No or Cooperative	No or Cooperative	Yes
Space Debris remediation	No	No	No	Yes or No
Adversarial close-proximity action	No	Counteracting	Counteracting	No

We have set up a research proposal to develop the processing framework needed to add this functionality to star trackers.

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